M.O. 359.

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The Thunderstorm of May 6th, 1933

On the afternoon of Saturday, May 6th, thunderstorms were widespread in the north of England and in the Midlands. They occurred just in front of a cold-front occlusion which moved north-eastwards over the country and which was associated with a small depression which developed south-west of Ireland during the night. The thunderstorms well exemplify some of the points made by Mr. Douglas in his article in the *Meteorological Magazine* for April.

On Friday, May 5th, an occlusion had passed over England and at 13h. G.M.T. stretched from the Hebrides south-eastwards through Yarmouth to north France. To the air over England, therefore, the tag " maritime sub-polar " could be attached. An upper air record obtained at Duxford at 12h. 15m. G.M.T., however, indicated that at that time the polar air extended upwards from the surface to only about 8,000 feet. The observations made at 6h. G.M.T. the following morning showed this, for by that time the temperature right up to about 16,000 feet had fallen considerably below that of Friday morning. Conditions on Saturday morning were then very favourable for the development of thunderstorms.

The synoptic situation at 7h. G.M.T. on Saturday was as follows:—A small centre of low pressure was indicated about 150 miles west - south - west of the Scilly Isles with a

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cold-front occlusion running south-eastwards to Socoa in south-west France and about 100 miles south-west of Brest. The main centre of low pressure was about 200 miles west of Blacksod Point. Winds over England were south to south-east generally and were strong in the western Channel. Pilot balloon and nephoscope observations showed that there was a fairly uniform southerly current up to the cirrus level over the greater part of England at least.

At 13h. the occlusion stretched south-eastwards from Pembroke to Portland Bill and Cherbourg. Thunder was reported at Upper Heyford and Ross-on-Wye in the past weather at this hour and Ross-on-Wye had had a heavy shower. Between 13h. and 16h. Upper Heyford had a thunderstorm, and by 18h., when the front stretched from about Liverpool to just east of London, thunderstorms had occurred at Birmingham, Catterick and Harrogate. At the last two places they were still raging at the hour of observation. Thunder had occurred at Liverpool and a heavy shower at Sealand. Health resorts' reports showed also that the following places had thunderstorms during the afternoon :—Morecambe, Blackpool, Southport and Ilkley.

The speed of movement of the front after 18h. decreased considerably and it became almost stationary during the night along the east coast of England.

There seems little reason for doubt that the advance of the cold-front occlusion was the trigger action which started the thunderstorms and that they were carried along in front of the occlusion by the upper wind. The fact that they occurred mainly in the Midlands and north was probably due to the greater land track covered by the air in these regions compared with air further south. A letter from Mr. A. E. Moon, of Hastings, seems to show, however, that surface heating on the continent was responsible for a thunderstorm immediately on the front in his neighbourhood. He writes as follows, describing a line-squall. (All times are G.M.T.)

"Weather previous to the approach of the squall was fine, though cloud, consisting chiefly of alto-cumulus, began to increase about three-quarters of an hour before the squall cloud appeared. At between 16h. 30m. and 16h. 45m. heavy clouds were seen to be approaching from the south-west, the extreme front of the cloud-bank consisting of a long band of alto-cumulus castellatus of a large variety, stretching from near south-south-east to north-west. As this band of cloud advanced it gradually resolved into a layer of dense black alto-stratus but still retaining the banded formation. The approach of this cloud-bank at 16h. 45m. appeared to be very slow. Just behind the dense alto-stratus cloud there was a heavy mass of grey cloud which was of low altitude and showed signs of turbulence, especially at its southern extremity. The wreath cloud of the squall passed

overhead at a good speed towards the north-east at 17h. 3m., and simultaneously the wind, which had before 17h. been blowing light (about 10 m.p.h.) from east-south-east, suddenly whipped over to south-south-west and blew at a speed between 21 and 27 m.p.h. Behind the wreath the sky for some distance was covered with heavy blue-black cloud at a greater height than those forming the front of the squall, while nearer the horizon a grey uniform sheet of rain was gradually advancing. This did not reach the station until 17h. 20m., after which time it quickly became heavy, then very heavy at 17h. 27m. being of large drops; it became less heavy for a time at about 17h. 35m., but still continued heavy until it ceased at 18h. 37m. Thunder and lightning were observed at 17h. 42m. but no details as to distance or direction are available, but was probably not beyond four miles away; thunder was again heard, this time to the south-south-east at 17h. 49m. Weather remained dull after the cessation of the rain at 18h. 37m.

Soon after the squall of the wind to the south-south-west at 17h. 3m. the direction became south-westerly, but in about half-an-hour had again become light and variable in direction. At 18h. the direction was south-south-west, 10 m.p.h., after which it backed through south to south-east, and coming from the north-east at 18h. 30m. but not remaining in any direction long.

Thunderclouds were seen slowly developing over the sea, but not inland, during the middle of the morning, while lines of typical alto-cumulus castellatus were also seen developing."

The occlusion passed over London at about 16h. 50m., and as it became very diffuse over south-east England it is unlikely that it reached Hastings so early as 17h. 3m. The probability is that the earlier phenomena described by Mr. Moon were associated with a local thunderstorm, but in this case the storm was so close to the front that there was no way of differentiating between the thunder-squall and the front squall.

Another description of a line squall on this day was received from Mr. Donald L. Champion of Waltham Cross, Herts. His description was as follows:—" A well-marked line-squall passed here on May 6th. The morning had been fine, with little cloud, mostly cirrus, but during the afternoon much cumuliform cloud was observed to be coming from the west, becoming lower and denser as the afternoon advanced.

At 15h. the wind was ESE., force 1 and shade temperature had reached 68°F.; by 17h. the thermometer had fallen slightly to 66°F. and the ESE. wind freshened slightly to force 2. Soon after 17h. I observed a heavy bank of cloud approaching from the west-south-west; this cloud had a well-defined stratified base and reached the zenith at about 17h. 20m. At the same time the wind, in a gust of about force 6, suddenly veered to SW. and the temperature, in five minutes, fell to 61°F. By 17h. 40m.

the temperature had fallen to 58°F. and the wind lessened to about force 4, and by 18h. 10m. had abated to a steady breeze, from SW., force 3, the thermometer having resumed its slow fall, being then at 57°F. No rain fell except a slight shower at 18h. 45m.

A friend of mine, who was about two miles west of Great Missenden, which lies about 30 miles due west from here, reports that the squall struck him at about 15h. 55m."

(The times referred to in this letter are presumably B.S.T.)

In this case it appears that the squall was associated with the occlusion itself and not with a thunderstorm. The phenomena described are consistent with what happened as the occlusion passed over several telegraphic reporting stations, including London.

J. S. Farquharson.

Roll Cloud seen at Eastbourne, May 6th

During a fine afternoon on May 6th, 1933, at about 5 p.m. B.S.T. looking in a south-west direction towards Beachy Head from Eastbourne front, I observed a curious phenomenon known as a roll cloud. This cloud stretched from the back of Beachy Head to the horizon line out at sea, and was approaching broadside on. The colour of the roll itself was white, while a heavy mass of cloud following directly behind was dark grey which suggested nimbus. As this white roll grew nearer a white straggling mass of cloud seemed to hang from the bottom of the roll cloud which gave the impression of a large white curtain hanging down. When the cloud approached Beachy Head the roll broke up into two pieces; one portion went out to sea, and the other over the hills. During the time of the approach of this cloud a dead calm prevailed but a moderate breeze blew up from a south-west direction as it passed overhead. After the front had passed, which took about 20 minutes, the spectacle vanished and steady rain fell for about half an hour.

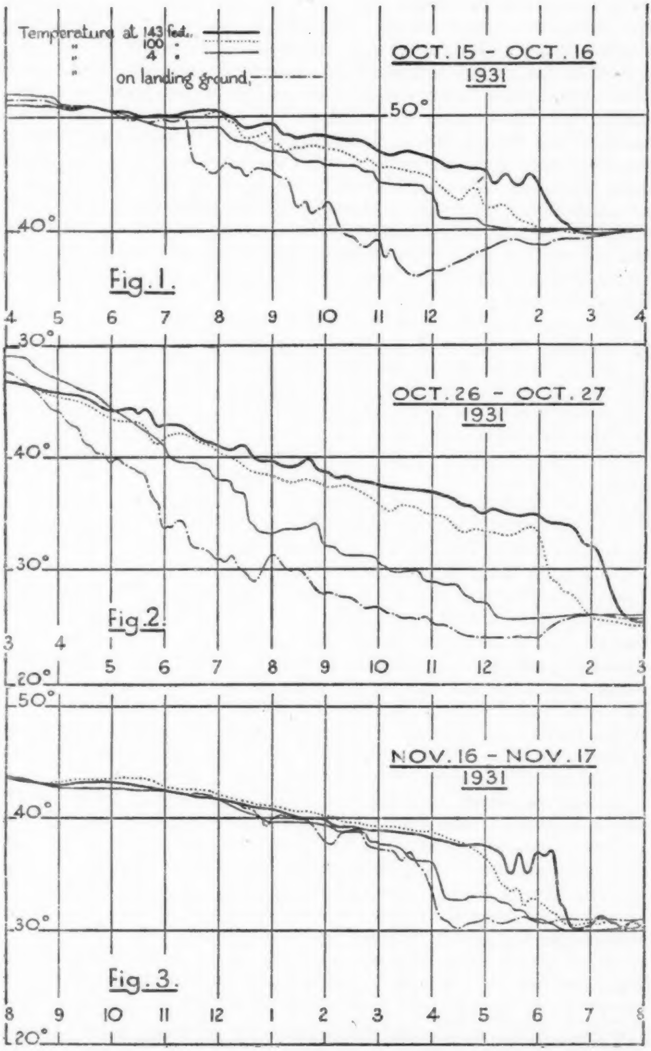
J. Monger.

17, *St. James' Mansions, Muswell Hill, N.*10. *May* 17*th*, 1933.

[For a photograph of a similar roll cloud see the illustration facing page 129 of the July, 1932, *Meteorological Magazine*.—Ed., *M.M.*]

A Note on Radiation Fog

The curves which are shown in Figures 1 to 3 are, perhaps, worthy of reproduction. They are the curves of temperatures on certain occasions at heights of 143 feet, 100 feet and 4 feet above ground level at Cardington. The fourth curve in each figure is that at 4 feet above ground level over ground about 28 feet lower



Temperature at 143 feet
" 100 "
" 4 "
" on landing ground
OCT. 15 - OCT. 16
1931
50°
40°
Fig. 1.
4 5 6 7 8 9 10 11 12 1 2 3 4
30°
OCT. 26 - OCT. 27
1931
40°
30°
Fig. 2.
3 4 5 6 7 8 9 10 11 12 1 2 3
20°
50°
NOV. 16 - NOV. 17
1931
40°
30°
Fig. 3.
8 9 10 11 12 1 2 3 4 5 6 7 8
20°

than that above which the other records were made. The first, second and fourth curves were recorded by platinum resistance thermometers (unaspirated), the third curve by a bimetalic thermograph. The curves are remarkable, showing as they do a sudden fall in the temperature successively at each height and after the fall a very steady and uniform temperature. On examining the weather recorded in the mornings of these occasions it was found that a dense fog (visibility less than 200m.) was reported on each occasion. And the same was found on some other occasions when similar features were recorded though not so markedly. On each of these three occasions the wind at 50 and 150 feet was nil. Clearly the fall in temperature occurs when the fog reaches the level of each thermometer in turn, the cooling being due to radiation which is escaping from the surface of the drops composing the fog.

From such curves as the first three of each figure, it is possible to calculate the upward speed of propagation of the fog surface, as well as the depth of the inversion layer at the top of the fog (for the latter the assumption being made that the depth of the inversion does not materially change during its passage past any one thermometer); the values are given in the table below :—

Date (1931).		*Upward speed of fog surface.*	*Depth of Inversion.*
October	15th-16th	1·8 to 0·6 feet per min.	30 feet
,,	26th-27th	About 0·7 ,,	42 ,,
November	16th-17th	1·5 to 0·6 ,,	22 ,,

As I have said, the fog is primarily due to radiative cooling from the surfaces of the water drops. This cooling is propagated in turn to the air by conduction and radiation. The cooling of the air to the dewpoint above the fog must be a somewhat complicated process. A radiative transfer of heat occurs from the water vapour above the fog to the fog drops themselves as well as to the water-vapour in the air within the fog, while there is, too, a transfer of heat by turbulence. It would appear that these three forms of heat transfer are all important, and so the equation of heat transfer cannot be expressed in a simple form.

A feature occurs in Fig. 3 to which Mr. Brunt* has already alluded, namely, the fluctuations in temperature in the surface of inversions (*e.g.*, between 5h. 20m. and 6h. 20m. G.M.T. at 143 feet). A possible explanation is that, with a suitable vertical distribution of water-vapour, the upper layers of the fog may be cooled down below the lower layers and instability may then arise within the fog which will set up convectional cells. The movement of air in these cells will give rise to an indentation of the fog's surface, which will be reproduced on the thermograph as temperature fluctuations such as those shown in Fig. 3. This

* Notes on Radiation in the Atmosphere. By D. Brunt, *London, Q.J.R. Meteor. Soc.* 58, 1932, *p.* 389.

supposition of instability within the fog would too account for the well-known phenomena of the sudden thinning of fog over small areas, an explanation which was suggested to me tentatively by Mr. Giblett some years ago. It would be interesting to know if aircraft flying over fog ever observed such indentations from above. I know of no such case except on one occasion when the Airship R.100 flew for some hours over an extensive fog covering the Midlands. On that occasion, I understand, irregularities were seen in the fog's surface, but from the recollections of her officers there was no regular pattern evidenced. If, however, any sort of regular pattern could be identified, it might be turned to practical use by the aviators, since the size of the cells would afford a means of determining the depth of the fog.

C. S. Durst.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 17th, in the Society's Rooms at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, M.A., F.Inst.P., Vice-President, in the Chair.

D. Brunt, M.A., B.Sc.—The adiabatic lapse-rate for dry and saturated air.

The equation giving the saturated adiabatic lapse-rate is derived as an energy equation, and a slight approximation makes it possible to reduce this to a form suitable for direct computation. The results obtained are represented graphically, isopleths of different values of the saturated lapse-rate being shown with pressure and temperature as co-ordinates. An alternative derivation of the fundamental equation for rising saturated air is given, which, by assuming the principle of entropy from the beginning, reduces the derivation to very brief compass.

C. S. Durst, B.A.—Notes on the variations in the structure of wind over different surfaces.

From an examination of anemograms in favourable situations it is found that over the sea the short-period fluctuations in wind are greater in tropical air than in polar air, although when inversions of any magnitude occur over the sea, smooth-flowing air can persist with higher velocities than over agricultural land. An example is shown of the structure of wind over desert; finally the frictional churning of the air due to a town is examined, and the consequential effects on temperature are found to be appreciable.

C. E. P. Brooks, D.Sc., and Theresa M. Hunt.—Variations of wind direction in the British Isles since 1341.

Regular observations of wind direction began near London in 1667, at Edinburgh in 1731 and at Dublin in 1725, and

extend, with gaps in the earlier periods, to the present day. For these three cities the resultant wind direction and " constancy " are given for each winter, summer and year. Over nearly the whole series the prevailing wind has blown from about WSW., but abnormally frequent easterly winds were recorded during the period 1740 to 1748 in London and Dublin and during the period 1794 to 1810 in London. The present century has been remarkable for the persistence of southwesterly winds. Before 1667 observations are scanty, but Merle's diary shows a dominant wind from WSW. in the years 1341 to 1343, while there is good evidence that easterly winds were abnormally frequent during the latter half of the sixteenth century.

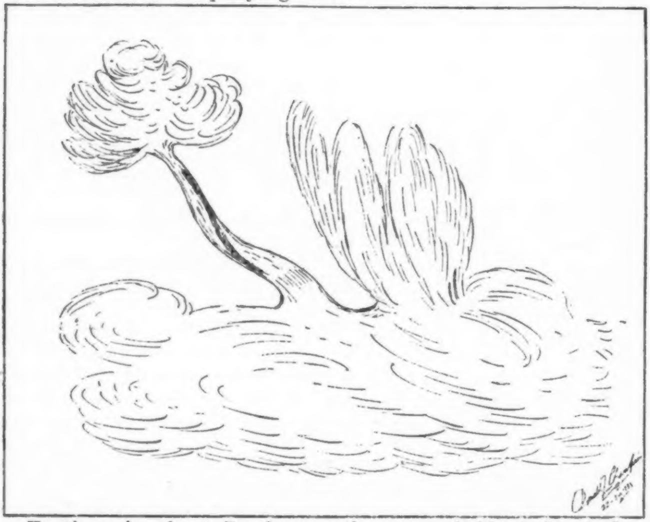
Correspondence

To the Editor, *The Meteorological Magazine.*

Cirrus Cloud Formation

On the evening of May 20th, at 18h. 35m. I was at a point about 310 ft. above Ordnance datum on Dean Hill, about 6½ miles east-south-east from Salisbury.

The sky at this time was almost covered with a mosaic of cirrus and patches of cirro-cumulus; but in the south-east at an altitude of about 40°, I observed the peculiar cloud formation shown in the accompanying sketch.



Further, in about 7 minutes, the upper half of the darker shadow became twisted spirally across the pendant as shown,

which seems to indicate that the latter was revolving in an anticlockwise direction. At the same time the pendant became slowly elongated horizontally as if the upper portion was moving faster than the lower; and after about 15 minutes the pendant became more diffuse and finally the whole pattern merged into a continuous sheet of cirrus.

Was the pendant the " slow motion " equivalent of a " water spout " in the cirrus region?

D. L. CHAMPION.

187, *High Street, Waltham Cross, Herts.* *May 23rd*, 1933.

Sun-Pillar seen from Hastings

This evening about 18h. 45m. I saw about 2° of what seemed to be an orange sun-pillar rising from a cloud which hid the sun. Immediately above the sun was a short segment of the 22° halo, the only part of the halo visible.

CICELY M. BOTLEY.

Guildables, 17, *Holmesdale Gardens, Hastings.* *May 15th*, 1933.

Brilliant Rainbow, May 7th

A brilliant rainbow was observed by Mr. E. W. Montagu Murphy, of Ballinamona, Cashel, Co. Tipperary, at sunset on May 7th, 1933. The colours in the main bow were very bright and later secondary bows developed so that at 7.20 p.m. four complete bows were visible.

Heavy Rainfalls in Scotland

On the 2nd of April rain to a depth of 6·50 inches was recorded at Dunhulladale, Loch Carron, Ross-shire. The observer confirms the measurements, the authority in a letter stating:—" it was confined to a small area here. I cannot say exactly when it commenced but it was of long duration and very heavy at times. The amount 6·50 inches is quite correct although I am sorry I cannot give the exact time it commenced or stopped. It was the greatest fall in 24 hours I have noted (commencing 1914). I heard that it was comparatively small at Achnashellach and Opinan (Gairloch) and even ½ mile from here it was nothing extra."

During the period 1865-1931 on only four occasions have falls greater than this been reported for a rainfall day in Scotland, namely:—

Ben Nevis Observatory,	7·29 in.	on	October	2nd, 1890
,, ,, ,,	7·74 ,,	,,	February	6th, 1894
Croy (Dalcross Castle),	7·06 ,,	,,	September	25th, 1915
and Loch Quoich (Kinlochquoich),	8·20 ,,	,,	October	11th, 1916

Other large daily values on April 2nd, 1933, were—
3·13 in. at Glenquoich,
3·60 in. at Glen Etive,
and 4·14 in. at Kinlochquoich.

A. H. R. Goldie.

Meteorological Office, 6, *Drumsheugh Gardens, Edinburgh* 3. *May* 10*th*, 1933.

Another Thunderstorm Phenomenon

I have just received details from Mr. E. W. Cooper, of Minehead, Somerset, about a thunderstorm phenomenon which is new to me. It was observed by him and his son during a severe storm, at Minehead, in May, 1930. One observer was using a wireless set with headphones and the other was watching the storm. A sound was heard in the phones an appreciable time before the lightning was visible—in fact the listener had time to say " look out " before the other observer saw the flash. The time taken for this, together with the listener's personal equation, must have been 0·2 second at least. I can find no reference to any similar observation. Theoretically an explanation is difficult to find, since wireless waves and visible light are both electromagnetic and are propagated through the ether with the same velocity. Yet Mr. Cooper has no doubt that the time interval was real.

It is interesting to compare this with the " vit " or " click," which was not observed, however, on this occasion. The sequence of events there is (*a*) flash and " vit " together, (*b*) thunder. In the Cooper phenomenon the sequence is (*a*) sound in the headphones, (*b*) flash, (*c*) thunder-claps. Are the two phenomena related, and can anyone throw further light on the problem?

S. E. Ashmore.

22, *Soho Road, Handsworth, Birmingham* 21. *May* 27*th*, 1933.

Summer Thunderstorms

The comments on my article by Col. Gold in the May number of the *Meteorological Magazine* (which he was good enough to show me before sending them) do not reveal any very serious clash of opinion, but after consideration I think that some further remarks might help to clarify the position. It is extremely difficult in meteorology to be precise and accurate and to find words which convey the same ideas to all readers. The trouble arises mainly from the complexity of the atmosphere itself, but it is incumbent on meteorologists to do their best to minimise the evil. My reference to a " misleading notion " was based on statements I have seen in the past, which were not connected with forecasting in north-east France, however the " notion " may have arisen. The following points must be emphasised in con-

nexion with thunderstorms associated with south-westerly above south-easterly currents:—(*a*) Temperature rises in the layer where the wind veers rapidly with height; (*b*) temperature does not always fall at greater heights in the 12 to 24 hours before the storm though it sometimes does; (*c*) temperature generally exceeds the seasonal normal at all heights; (*d*) super-adiabatic lapse-rates are not necessarily involved, and have not hitherto been observed in such cases. Any statement of the position which gives a wrong impression on any of these points deserves to be called misleading.

I have always regarded a wind veering upwards in the lowest 5,000 feet as favourable for thunder, owing to its indicating the arrival of warm air, and have said so more than once in print. In my recent article I toned down the statement to the following*:—" Sometimes it certainly appears as if the advection of warm air in the lower levels, associated with a wind veering upwards, increases the lapse-rate at the top of the layer affected, and helps the development of thunderstorms." This increased caution was forced on me by the figures given in the previous paragraph, which (much to my surprise) actually showed a slightly larger proportion of storms when the wind was in the south-east quadrant at both 1,000 and 5,000 feet, than when there was a SW. wind over the SE. wind. The former cases often showed some veer, but less on the average than the latter. The fact is that diurnal convectional storms are numerically preponderant (especially when the criterion is the occurrence of thunder anywhere in an area) and that these are not normally associated with much wind shearing. Layers of marked shear are usually of the nature of sloping surfaces of discontinuity, with the warmer air above, and possibly also the shear may interfere mechanically with convection of the ordinary diurnal type. I have examined the pilot balloon observation for the summer of 1931 in the south-eastern area in relation to thunderstorms reported between 13h. and 18h. in the *Daily Weather Report* (at any station in districts 1, 2 and 3), and find that the average vector change of wind with height was less on the days of afternoon thunderstorms than on the other days, the difference being slight (and perhaps of no genuine significance) in the layer from 2,000 to 5,000 feet but quite considerable in the layer from 5,000 to 10,000 feet.

The storms associated with marked shearing belong to a special category of storms of frontal type, with no marked diurnal variation. When there is a large veer with height, the simplest case is that of a warm front, with a suitable lapse-rate in the warm air mass. In most of such cases the surface wind is north of east and the upper wind is south-east or south, but some few of the storms with an upper south-west current

*See *Meteorological Magazine*, 68, 1933, *p.* 57.

are of warm front type, especially after the middle of August. In the height of the summer the solar heating on the continent is great, and forms a high lapse rate up to 5,000 feet, and it is difficult to estimate the effect of different factors. Many of the storms with a SW. over a SE. or S. wind accompany cold fronts (or cold front occlusions) from the Atlantic, and the steep horizontal temperature gradient in the warm air is not in general directly connected with the front itself, but is an additional effect peculiar to the summer months. (The reverse effect in winter is not quite analogous, since the surface cooling only diffuses upward very slowly, and has little effect on wind structure above 1,500 feet.) Even in summer many cold front storms have a more or less " solid " current in front of them. The severe storm early on August 12th, 1932,* was of this type, as shown by the pilot balloon ascent at Felixstowe.

A wind backing with height is usually found behind a cold front, after the thunderstorms, though sometimes belated storms occur behind the front, entirely in the warm current above. Storms in the polar air are of a different type.

As Col. Gold suggests in his note, each case must be considered on its merits, and the upper wind used in conjunction with other factors. An upper south-west current is favourable for thunder if it tends to bring over a front, or if it brings damper air, though the surface distribution of humidity must be intepreted with caution. Over the sea or on the coast there may be a very shallow layer of damp air, with dry air above. Over the land, on the other hand, the vertical gradient of absolute humidity is reduced by convection, so that a shallow layer of damp air is unlikely, especially in the afternoon.

C. K. M. DOUGLAS.

May 30th, 1933.

The Duration of a Lightning Flash

I am in considerable agreement with Mr. Lutkin's views as to the possible constitution of the lightning flash. I have always looked on it as an oscillatory phenomenon, and indeeed it was for that reason I regarded the photo I sent this *Magazine* in December as interesting, for it seemed to show the persistence of *something* during the $\frac{5}{8}$ second of the record.

Thus the interesting points about my ciné record seemed to me to be (1) the practical identity (as far as I could see) of the shapes of the first four of the five pictures, and (2) the fact that in the last faint photo, while there is a faint thread running through the flash, there are very evident " blobs " left in the positions of the darker portions of the first four pictures. These " blobs " unfortunately have not come out well in the reproduc-

*See *Meteorological Magazine*. 67, 1932, *pp*. 186-90.

tion, but I regarded them as evidence of the fading away of something.

Whether the current which caused the flash was unidirectional or oscillatory does not seem to affect this point that something—possibly corresponding to Mr. Lutkin's orange red glow—did have an extended existence in time. A slow-motion picture of a lightning flash would be a very interesting and welcome method of settling the point, though I fear it might involve the use of quite a number of feet of film before the time and the place and the loved one were found all together.

M. McCallum Fairgrieve.

37, *Queens Crescent, Edinburgh. May 10th*, 1933.

A Tornado at Peshawar

On April 5th, during the passage of a well-marked depression across the extreme north of north-west India, a tornado occurred in the vicinity of Peshawar Cantonment causing damage to crops, trees, kutcha buildings, &c.

The phenomenon was first seen at 12h. 35m. I.S.T. as a funnel-shaped appendage to a mass of dense and towering cumulonimbus cloud, and was preceded by a slight hailstorm. The funnel soon reached to the ground and by 12h. 45m., when the photograph (reproduced as the frontispiece of this number of the *Magazine*) was taken, it had developed into a curved dark column of upward-spiralling winds. Subsequently the twisting column of air and water vapour became distorted and attenuated, finally disappearing at 13h. 10m.

The diameter was probably about 30 yards and the length of path about 5 miles. As the tornado—an almost unknown phenomenon in this part of the world—only lasted for 35 minutes, and, fortunately passed over open country, very little damage was done.

On the other hand, the storm did not come near enough to the Meteorological Office to affect the recording instruments to any marked degree. It appears certain, however, that the phenomenon was the result of vigorous convection between relatively strong and superadjacent counter-currents of different origin.

A full account and discussion of the storm is being prepared for subsequent publication.

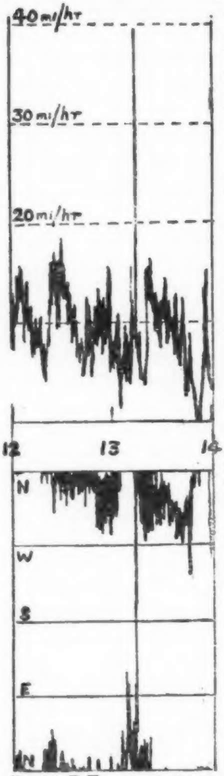
R. G. Veryard.

No. 1 (*Indian*) *Group Headquarters, R.A.F., Peshawar. April 17th*, 1933.

Small Whirlwind at Eskdalemuir

A small but violent whirlwind crossed the Observatory grounds from north to south at 13h. 12m. G.M.T. to-day, Sunday, May 14th, 1933. A strong easterly wind was first noticed at a

point about 70 yards north-east of the anemometer mast, and immediately afterwards a well-defined "whirl," two or three feet in diameter and containing pieces of grass, twigs and other debris, was seen to move south at a speed of about 10 m.p.h., passing through the gap between the main Observatory building and one of the houses, some 30 yards to the east of the anemometer mast.



DINES P.T. ANEMOGRAM ESKDALEMUIR, MAY 14TH, 1933.

Examination of the anemogram shows an isolated gust of 40 m.p.h., but it is impossible to tell from what direction the wind came, as the vane made a complete revolution at that time. The wind immediately before and after was 8 m.p.h. from north. Pressure as shown on the float barograph fell and rose about 1 mb. almost instantaneously. The weather was "bc" at the time with 6/10 fair weather cumulus and strato-cumulus at 3,500 ft., and as far as could be seen the whirlwind did not extend to that height. Temperature remained fairly steady at 57°F., and relative humidity 35 per cent. in the large Stevenson screen.

The morning had been rather warm with strong sunshine, and presumably the whirlwind was moving from the higher hills down the valley along the wind, although its course could not be followed owing to the configuration of the ground.

Later in the evening at about 17h. 30m. G.M.T. a violent agitation of the trees was heard to the north-east of the Observatory, about 300 yards from the anemometer, as if another small whirlwind was passing, but no strong gust was recorded on the anemometer as in the earlier case.

LESLIE H. J. STONE.

Eskdalemuir Observatory, Langholm, Dumfriesshire. May 18th, 1933.

Slow-moving Clouds

As evidence of the unusually small movement of air at 2,500-3,000 feet in this district on Sunday, April 30th, 1933, the following observation was considered noteworthy.

Cumulus clouds moved slowly from south-west during the day

with gradually decreasing velocity. By 5 p.m. G.M.T. it was calm and a detached cloud remained stationary (*i.e.*, not moving 100 yds.) overhead from 5 p.m. to 8 p.m., after which its identity was lost among increasing clouds. Cirrus could be seen above moving from south-west or west-south-west.

R. M. POULTER.

28, Pinner Park Avenue, Headstone Lane, Harrow. May 5th, 1933.

NOTES AND QUERIES

The New Primary Standard Barometer at the National Physical Laboratory

In 1912 the work of verifying barometers was transferred from Kew Observatory to the National Physical Laboratory at Teddington. The original standard barometers were left at Kew, while a new large bore working standard of the Fortin type was provided for the N.P.L., and carefully compared with the old Kew standards. The late Sir George Beilby, F.R.S., gave a sum of £200 for the purpose of constructing a new primary standard for use at the Laboratory, and a recent paper* in the *Proceedings of the Royal Society* gives a full description of its construction and details.

With modern systems of pumping it is comparatively simple to obtain a very low pressure within an enclosure. It was, therefore, not necessary to construct the new standard barometer of glass tubing permanently sealed off. The barometer consists essentially of a U-tube bored in a solid block of stainless steel. The upper end of the longer arm is connected with a mercury vapour condensation pump, and the other arm is open to the air. The mercury surfaces are observed by means of two micrometer microscopes and "collimators," through optically flat and parallel glass windows placed in pairs and sealed on to specially ground surfaces of the steel. Great attention has been devoted to the method of reading, which is described in detail; briefly, the level of the mercury is taken as midway between the real image of a horizontal cross-wire and its reflection in the mercury surface. The microscopes are mounted on a massive carriage. After the microscopes have been adjusted on the upper and lower surfaces of the mercury the carriage is moved through a few inches transversely and readings can then be taken through the microscopes on the scale of inches. The temperature of the mercury column is obtained from a thermometer with a bulb thirty inches long, which is completely immersed in mercury in a hole bored through the length of the stainless steel block; corrections were determined to the nearest ·002°C. The line

*A new primary standard barometer. By J. E. Sears, Jnr. and J. S. Clark. *London, Proc. R. Soc.*, 139, 1933, *pp.* 130-46.

standard is of invar. There is also a reservoir provided with a plunger by means of which the mercury can be drawn below the level of the windows when the barometer is not in use.

The new primary standard has been compared with the semi-portable standard and with the working standard Fortin at the Laboratory. As a result of a number of readings, the latter was found to read ·0015 inch above the new primary standard, the individual differences ranging from ·0001 inch to ·0029 inch. The uncertainty of a single reading of the new standard is about ·0002 inch, while that of the working standard Fortin is about ·0006 inch.

A letter from Mr. J. E. Sears to Dr. F. J. W. Whipple states that the standard Fortin barometer, which was compared with the Kew standards in 1912 and 1914, has probably not changed its index error by more than ·001 inch since 1914. The recent comparisons of this standard Fortin barometer at the N.P.L. with the new primary standard therefore show that the Kew standards were not in error by more than $\pm$·001 inch in 1912 and 1914. This is a matter for great satisfaction. The Kew standards consist of two barometers with very large cisterns and large tubes set up in 1855 and 1859 respectively, together with a cathetometer set up in 1876. The "old" standard barometer is the one set up and described by John Welsh.* The "new" one was erected because it was feared that the "old" one had been damaged by workmen. The consistent results of the recent tests indicate not only that the barometers were well made in the first instance but also that the vacua have been maintained (in glass over mercury) for three-quarters of a century.

The Proportion of the annual Rainfall occurring on the wettest days of the year

With reference to Mr. R. C. Sutcliffe's article in the October issue, the following information relating to British stations may not be without interest:—

(*a*) In *British Rainfall*, 1926, page 274, it was shown that the correlation between annual rainfall totals for the 35 years, 1881 to 1915, and the number of rain-days (0·01 in. or more) was +0·48, while with wet days (0·04 in. or more) the correlation is greater, being +0·63. So that about 40 per cent. of the variation in the number of wet days from year to year can be associated directly or indirectly with the variation of rainfall amounts.

(*b*) In *Water and Water Engineering*, March, 1932, page 120, some statistics are given of the daily rainfall amounts for ten years as recorded at Camden Square (London) and Dungeon

* *London, Phil. Trans. R. Soc. A.* 146, (1856), p. 507.

Ghyll, in the English Lake District. These stations were selected as having widely different averages, viz., 24·5 in. and 109·3 in. respectively, and the average number of rain-days also differs widely, owing to the steady increase in the number of days with rain from the south-east to the north-west of England and Wales. In spite of these differences the proportions of the total annual rain contributed by the wettest days of the year (not necessarily consecutive) are similar. The values given below are the means of the percentages obtained for each of the ten years:—

Number of Days	*Camden Square* *Per cent. of Annual Rainfall*	*Dungeon Ghyll* *Per cent. of Annual Rainfall*
7	22·3	17·7
15	37·5	30·1
30	57·0	47·6
50	73·8	64·0
70	84·2	75·4
100	93·2	86·8
150	99·0	96·4
170	99·8	98·1

These statistics show that in England about 20 per cent. of the total rainfall occurs during the wettest seven days of the year, 50 per cent. occurs during about 30 days, and 75 per cent. during about 60 days.

J. GLASSPOOLE.

L'Association française pour l'Avancement des Sciences

The Annual Congress of l'Association Française pour l'Avancement des Sciences will be held at Chambery (Savoie) during July. The President of Section VII, Meteorology and Geophysics, is M. Wehrlé, Assistant Director of the Office National Météorologique, Paris. The programme includes discussions on a number of meteorological subjects, but the situation of Chambery at the foot of the Alpine massif gives especial interest to that on the influence of relief on atmospheric phenomena, notably in the Alps.

Visitors to the Congress, and papers for reading and discussion, will be welcomed. If authors are unable to be present in person, M. Wehrlé will be pleased to present papers on their behalf.

Meteorological Society of Chile

A circular dated December 14th announced the formation of the "Sociedad Nacional de Meteorologia," the address of which is "Casilla 717, Santiago de Chile."

The study of meteorology has been actively followed in Chile for many years, and we wish the new Society all success in continuing the work.

New Meteorological Stations in Malaya

The annual report of the Federated Malay States Survey Department contains the news that, in addition to the seventeen meteorological branch stations, telegraphic reporting stations have been established at Ipoh and Seremban, under the control of, respectively, the Hydraulic Engineer, Perak, and the Medical Officer, Seremban Hospital. Arrangements have also been made with the Government of British North Borneo whereby the conditions at Sandakan are now cabled twice daily to the Head Office in Singapore.

New Meteorological Station in Formosa

A meteorological station was formally opened on Mt. Arisan, in central Formosa, on March 15th. The buildings vary somewhat in elevation, but stand between seven and eight thousand feet above sea level. The new station is supplementary to the Central Observatory in Taihoku and the Marine Meteorological Station in Takao, the latter of which was established in 1931 on the site of the old British Consulate.

The co-operation of the new station should add considerably to the reliability of the already valuable weather reports issued in Formosa, where the gradual development of military, naval and commercial aviation will render such information more and more essential. Facilities for a variety of other scientific studies and observations have also been provided at the new observatory.

News in Brief

A course of training for meteorological observers was held in the library of the Meteorological Office on May 9th and 10th, 1933, and was attended by twenty persons.

The Weather of May, 1933

Pressure was below normal over the United States and Canada (except for California and part of the North-West Territory) across the North Atlantic (including Madeira and the Canary Islands, southern British Isles, Denmark, Netherlands and northern France to central and eastern Europe, the greatest deficits being 4·8 mb. at Point Barrow, 7·2 mb. at 50°N.50°W, and 5·5 mb. at Astrakhan. Pressure was above normal over Spitsbergen, Iceland, Norway, most of Sweden, northern Russia, the Iberian Peninsula, western Mediterranean and southern North Atlantic (including the Bermudas and Azores), the greatest excesses being 6·8 mb. at Jan Mayen and 2·7 mb. at Madrid. Temperature was above normal at Spitsbergen and in the western regions of Europe, but below normal in eastern Gothaland and Svealand in Sweden and in central Europe, while rainfall was deficient at Spitsbergen and most of Scandinavia but in excess in central Europe.

The outstanding feature of May over the British Isles was the prevalence of thundery conditions; temperature was above normal generally, but sunshine was deficient and rainfall variable. Pressure was high over the British Isles during the first day of the month, but on the 2nd a depression off the Bay of Biscay, which was moving slowly northwards, caused unsettled weather with easterly winds in the south. In Scotland the 2nd was a very sunny day with 14·2 hrs. bright sunshine at Inverness and 13·6 hrs. at Aberdeen. By the 3rd, however, the influence of the depression had spread also over Scotland, and from then until the 11th a complex low-pressure system lay over the British Isles maintaining unsettled conditions. Thunderstorms occurred on the 1st-3rd, 6th and 9th, and winds were strong locally at exposed places on a few days. Rainfall during this period was usually slight or moderate, but some isolated heavy falls occurred on the 6th, 1·91 in. at Limerick, 1·30 in. at Skegness, and 1·12 in. at Jersey, while sunshine was variable, 14·2 hrs. occurred at Tiree on the 10th. During the 12th, 13th and 14th the weather was fair to cloudy in England and Ireland, but in Scotland there was much sunshine generally, Tiree had 13·6 hrs. and Oban 13·3 hrs. on the 13th. On the 14th the fine weather was spreading further south, Malin Head had 14·7 hrs. and Southport and Douglas both 14·5 hrs. bright sunshine; while the 15th was fine over the whole country. On the 16th the depression over the Atlantic extended its influence eastwards over the British Isles and the weather became cloudy and unsettled, with slight rain locally except in south-east England until about the 20th. Pressure became high over the country on the 21st, and except for small breaks remained so until nearly the end of the month. Thunder was heard frequently and thunderstorms occurred in some parts of the country most days; these were accompanied by heavy rain in the south on the 23rd, 2·47 in. at Banstead (Surrey) and 1·85 in. at Woking. Other isolated moderate falls later in the month were also associated with thunderstorms, 0·91 in. at Ross-on-Wye on the 27th, and 0·71 in. at Lympne on the 29th. During the first part of this period temperature was high, reaching 81°F. at Tottenham on the 23rd, and 79°F. at Tottenham on the 22nd, and Croydon and Tunbridge Wells on the 23rd; sunshine records were good except in the north. Temperature, however, fell in the north about the 24th and in the south on the 25th. The 26th was a generally sunny day, and from then to the 31st sunshine records were variable but mainly good. The Atlantic depression moved slightly eastwards on the 30th bringing rain to Ireland on that day, 0·83 in. fell at Valentia, but on the 31st the weather was again improving in the west. The distribution of bright sunshine for the month was as follows:—

(*continued on page* 128)

Rainfall: May, 1933: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	1·69	96	*Leis.* .	Thornton Reservoir ...	2·01	100
Kent .	Tenterden, Ashenden...	1·74	111	,, .	Belvoir Castle............	1·51	72
,, .	Folkestone, Boro. San.	2·49	...	*Rut* .	Ridlington	1·43	71
,, .	St. Peter's, Hildersham	...	...	*Lincs* .	Boston, Skirbeck	1·56	89
,, .	Eden'bdg., Falconhurst	2·90	156	,,	Cranwell Aerodrome ...	1·28	71
,, .	Sevenoaks, Speldhurst	...	...	,, .	Skegness, Marine Gdns	1·52	89
Sus .	Compton, Compton Ho.	3·22	145	,, .	Louth, Westgate	1·68	83
,, .	Patching Farm	2·67	144	,, .	Brigg, Wrawby St. ...	1·99	...
,, .	Eastbourne, Wil. Sq.	1·23	74	*Notts* .	Worksop, Hodsock ...	2·23	112
,, .	Heathfield, Barklye ...	1·55	86	*Derby* .	Derby, L. M. & S. Rly.	1·52	80
Hants .	Ventnor, Roy. Nat. Hos.	2·39	141	,, .	Buxton, Terr. Slopes	1·79	58
,, .	Fordingbridge, Oaklnds	2·04	98	*Ches* .	Runcorn, Weston Pt...	1·51	109
,, .	Ovington Rectory	1·77	81	*Lancs* .	Manchester, Whit Pk.	1·76	83
,, .	Sherborne St. John ...	2·02	104	,, .	Stonyhurst College ...	1·77	62
Herts .	Welwyn Garden City...	1·95	...	,, .	Southport, Hesketh Pk	1·62	77
Bucks .	Slough, Upton	1·47	87	,, .	Lancaster, Greg Obsy.	3·10	125
,, .	H. Wycombe, Flackwell	1·31	...	*Yorks* .	Wath-upon-Dearne ...	2·16	106
Oxf .	Oxford, Mag. College...	1·52	85	,, .	Wakefield, Clarence Pk.	2·45	124
Nor .	Pitsford, Sedgebrook...	1·43	75	,, .	Oughtershaw Hall......	3·59	...
,, .	Oundle.....................	1·61	...	,, .	Wetherby, Ribston H.	3·04	147
Beds .	Woburn, Crawley Mill	1·87	96	,, .	Hull, Pearson Park ...	1·92	100
Cam .	Cambridge, Bot. Gdns.	2·02	115	,, .	Holme-on-Spalding ...	2·65	...
Essex .	Chelmsford, County Lab	1·42	99	,, .	West Witton, Ivy Ho.	3.38	150
,, .	Lexden Hill House ...	1·18	...	,, .	Felixkirk, Mt. St. John	2·37	126
Suff .	Haughley House.........	1·03	...	,, .	York, Museum Gdns.	2·26	113
,, .	Campsea Ashe............	1·69	113	,, .	Pickering, Hungate ...	2·81	143
,, .	Lowestoft Sec. School	1·60	99	,, .	Scarborough	1·51	79
,, .	Bury St. Ed. Westley H.	1·56	86	,, .	Middlesbrough	1·98	103
Norf .	Wells, Holkham Hall	1·82	113	,, .	Balderdale, Hury Res.	...	...
Wilts .	Devizes, Highclere......	2·20	122	*Durh* .	Ushaw College	2·86	132
,, .	Calne, Castleway	2·46	131	*Nor* .	Newcastle, Town Moor	1·40	69
Dor .	Evershot, Melbury Ho.	2·39	117	,, .	Bellingham, Highgreen	1·87	78
,, .	Weymouth, Westham .	1·66	102	,, .	Lilburn Tower Gdns...	1·54	67
,, .	Shaftesbury, Abbey Ho.	2·54	120	*Cumb* .	Carlisle, Scaleby Hall	2·08	87
Devon .	Plymouth, The Hoe ...	1·88	91	,, .	Borrowdale, Seathwaite	4·50	65
,, .	Holne, Church Pk. Cott.	3·22	101	,, .	Borrowdale, Moraine...	4·41	...
,, .	Teignmouth, Den Gdns.	1·55	85	,, .	Keswick, High Hill...	3·03	95
,, .	Cullompton...............	2·34	108	*West* .	Appleby, Castle Bank	3·43	156
,, .	Sidmouth, Sidmount...	2·24	114	*Mon* .	Abergavenny, Larch...	2·88	108
,, .	Barnstaple, N. Dev. Ath	2·35	113	*Glam* .	Ystalyfera, Wern Ho.	2·21	63
,, .	Dartm'r, Cranmere Pool	3·90	...	,, .	Cardiff, Ely P. Stn. ...	1·75	70
,, .	Okehampton, Uplands	2·84	106	,, .	Treherbert, Tynywaun	2·20	...
Corn .	Redruth, Trewirgie ...	2·77	120	*Carm* .	Carmarthen Friary ...	2·21	80
,, .	Penzance, Morrab Gdn.	2·74	124	*Pemb* .	Haverfordwest, School	2·43	97
,, .	St. Austell, Trevarna...	3·51	145	*Card* .	Aberystwyth	1·19	...
Soms .	Chewton Mendip	2·02	73	*Rad* .	Birm W.W. Tyrmynydd	2·22	65
,, .	Long Ashton	2·22	105	*Mont* .	Lake Vyrnwy............	1·55	49
,, .	Street, Millfield.........	1·86	97	*Flint* .	Sealand Aerodrome ...	1·10	59
Glos .	Blockley	1·60	...	*Mer* .	Dolgelley, Bontddu ...	2·94	89
,, .	Cirencester, Gwynfa ...	1·92	93	*Carn* .	Llandudno	1·10	58
Here .	Ross, Birchlea...........	2·11	99	,, .	Snowdon, L. Llydaw 9	4·65	...
Salop .	Church Stretton.........	1·37	53	*Ang* .	Holyhead, Salt Island	1·49	76
,, .	Shifnal, Hatton Grange	1·85	90	,, .	Lligwy......................	1·60	...
Staffs .	Market Drayt'n, Old Sp.	1·58	72	*Isle of Man*			
Worc .	Ombersley, Holt Lock	1·44	70		Douglas, Boro' Cem. ...	2·33	92
War .	Alcester, Ragley Hall..	1·37	67	*Guernsey*			
,, .	Birminghm. Edgbaston	2·28	107		St. Peter P't. Grange Rd	1·45	85

Rainfall: May, 1933: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent of Av.
Wig .	Pt. William, Monreith	2·01	85	*Suth* .	Melvich	·98	48
,, .	New Luce School	2·79	98	,, .	Loch More, Achfary	1·38	31
Kirk .	Dalry, Glendarroch	4·24	135	*Caith* .	Wick	·72	35
,, .	Carsphairn, Shiel	3·70	88	*Ork* .	Deerness	1·43	72
Dumf .	Dumfries, Crichton, R.I	3·02	117	*Shet* .	Lerwick	·69	33
,, .	Eskdalemuir Obs.	2·52	76	*Cork* .	Caheragh Rectory	4·76	...
Roxb .	Branxholm	2·50	111	,, .	Dunmanway Rectory	5·44	160
Selk .	Ettrick Manse	2·22	60	,, .	Cork, University Coll.	4·57	202
Peeb .	West Linton	1·92	...	,, .	Ballinacurra	4·53	191
Berw .	Marchmont House	·89	36	*Kerry* .	Valentia Obsy	4·63	146
E. Lot .	North Berwick Res.	1·09	55	,, .	Gearahameen	5·70	109
Midl .	Edinburgh, Roy. Obs.	1·66	81	,, .	Killarney Asylum	...	...
Lan .	Auchtyfardle	...	...	,, .	Darrynane Abbey	3·23	108
Ayr .	Kilmarnock, Kay Pk.	2·11	...	*Wat* .	Waterford, Gortmore	3·62	157
,, .	Girvan, Pinmore	2·12	71	*Tip* .	Nenagh, Cas. Lough	3·85	156
Renf .	Glasgow, Queen's Pk.	2·63	108	,, .	Roscrea, Timoney Park	1·42	...
,, .	Greenock, Prospect H.	3·62	105	,, .	Cashel, Ballinamona	4·24	177
Bute .	Rothesay, Ardencraig.	3·34	...	*Lim* .	Foynes, Coolnanes	4·15	178
,, .	Dougarie Lodge	2·12	...	,, .	Castleconnel Rec.	4·57	...
Arg .	Ardgour House	3·27	...	*Clare* .	Inagh, Mount Callan	6·03	...
,, .	Glen Etive	4·25	85	,, .	Broadford, Hurdlest'n.	5·66	...
,, .	Oban	2·55	84	*Wexf* .	Gorey, Courtown Ho.	2·95	136
,, .	Poltalloch	3·68	127	*Kilk* .	Kilkenny Castle	2·26	104
,, .	Inveraray Castle	4·63	118	*Wick* .	Rathnew, Clonmannon	3·10	...
,, .	Islay, Eallabus	3·03	114	*Carl* .	Hacketstown Rectory	3·39	130
,, .	Mull, Benmore	3·60	...	*Leix* .	Blandsfort House	2·21	91
,, .	Tiree	2·39	96	,, .	Mountmellick	2·64	...
Kinr .	Loch Leven Sluice	1·65	68	*Offaly* .	Birr Castle	2·02	91
Perth .	Loch Dhu	3·30	73	*Kild'r.*	Monasterevin	...	...
,, .	Balquhidder, Stronvar	2·08	...	*Dublin*	Dublin, FitzWm. Sq.	2·82	138
,, .	Crieff, Strathearn Hyd.	2·02	81	,, .	Balbriggan, Ardgillan.	1·96	94
,, .	Blair Castle Gardens	1·52	75	*Meath.*	Beaupare, St. Cloud	1·99	...
Angus	Kettins School	1·35	50	,, .	Kells, Headfort	1·87	69
,, .	Pearsie House	1·47	...	*W. M.*	Moate, Coolatore	1·96	...
,, .	Montrose, Sunnyside	...	...	,, .	Mullingar, Belvedere	2·13	87
Aber .	Braemar, Bank	1·47	62	*Long* .	Castle Forbes Gdns.	2·30	89
,, .	Logie Coldstone Sch.	·67	27	*Gal* .	Ballynahinch Castle	4·44	123
,, .	Aberdeen, King's Coll.	·97	42	,, .	Galway, Grammar Sch.	3·35	...
,, .	Fyvie Castle	·94	36	*Mayo* .	Mallaranny	3·79	...
Moray	Gordon Castle	·66	31	,, .	Westport House	2·44	86
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	4·78	79
Nairn.	Nairn	...	...	*Sligo* .	Markree Obsy	2·80	102
Inv's .	Ben Alder Lodge	1·37	...	*Cavan.*	Belturbet, Cloverhill	2·69	108
,, .	Kingussie, The Birches	1·18	...	*Ferm* .	Enniskillen, Portora	2·75	...
,, .	Loch Quoich, Loan	1·98	...	*Arm* .	Armagh Obsy	2·57	108
,, .	Glenquoich	1·72	31	*Down* .	Fofanny Reservoir	5·92	...
,, .	Inverness, Culduthel R.	1·04	...	,, .	Seaforde	2·81	107
,, .	Arisaig, Faire-na-Sguir	...	...	,, .	Donaghadee, C. Stn.	2·21	97
,, .	Fort William, Glasdrum	2·40	...	,, .	Banbridge, Milltown	2·42	107
,, .	Skye, Dunvegan	1·16	...	*Antr* .	Belfast, Cavehill Rd.	2·87	...
,, .	Barra, Skallary	1·54	...	,, .	Aldergrove Aerodrome	1·63	72
R & C .	Alness, Ardross Castle	1·12	43	,, .	Ballymena, Harryville	2·44	85
,, .	Ullapool	·89	35	*Lon* .	Londonderry, Creggan	2·54	97
,, .	Achnashellach	1·46	33	*Tyr* .	Omagh, Edenfel	1·93	75
,, .	Stornoway	·92	36	*Don* .	Malin Head	1·94	...
Suth .	Lairg	1·33	52	,, .	Milford, The Manse	1·99	80
,, .	Tongue	1·40	59	,, .	Killybegs, Rockmount.	2·24	62

ERRATA: **Loch Quoich, Loan, April, for 3·10 read 13·10**
Glenquoich, ,, ,, 19·69 ,, 9·69
Achnashellach ,, ,, 0·43 ,, 10·43
Stornoway ,, ,, 12·85 ,, 2·85

Climatological Table for the British Empire, December, 1932

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	Absolute Min.	Mean Values Max.	Mean Values Min.	½ max. and min.	Diff. from Normal	Mean Wet Bulb	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	Diff. from Normal	Days	BRIGHT SUNSHINE: Hours per day	Per-cent-age of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F	°F.	%	0—10	in.	in.			
London, Kew Obsy.	1019·3	+ 5·6	55	30	46·8	38·5	42·7	+ 2·4	40·4	89	6·9	0·46	— 1·83	8	1·6	20
Gibraltar	1020·0	— 0·1	70	44	62·3	50·3	56·3	+ 0·3	51·0	87	5·9	7·25	+ 1·64	19	..	..
Malta	1023·2	+ 7·0	70	50	64·3	56·8	60·5	+ 2·6	55·1	75	6·5	1·30	— 2·41	8	5·6	57
St. Helena	1013·2	— 0·5	71	55	64·4	57·3	60·9	— 0·8	57·8	94	9·6	1·29	..	12	..	..
Freetown, Sierra Leone	1012·6	+ 1·7	88	69	85·7	74·1	79·9	— 1·5	76·0	85	4·3	2·54	+ 1·12	4	..	..
Lagos, Nigeria	1010·7	+ 0·7	91	71	88·6	75·1	81·9	+ 0·1	75·0	87	6·4	0·00	— 0·81	0	7·6	65
Kaduna, Nigeria	1012·8	— 1·5	98	48	91·1	54·9	73·0	— 0·3	55·7	43	1·3	0·00	0·00	0	8·8	77
Zomba, Nyasaland	1007·9	— 0·4	92	63	81·9	65·7	73·8	+ 0·7	68·4	73	7·3	8·13	— 2·74	21	..	..
Salisbury, Rhodesia	1010·4	— 0·8	83	56	77·2	60·6	68·9	— 0·7	63·1	75	8·2	6·90	+ 0·81	22	4·4	33
Cape Town	1014·5	+ 0·2	93	52	77·5	59·6	68·5	+ 0·6	60·5	63	3·8	1·61	+ 0·80	6	..	..
Johannesburg	1009·7	— 0·1	86	49	77·5	55·1	66·3	+ 0·8	57·5	65	5·5	2·54	— 2·89	19	8·0	58
Mauritius	1015·3	+ 1·3	90	64	83·5	69·4	76·5	— 1·8	71·4	73	6·0	1·56	— 3·17	16	9·0	68
Calcutta, Alipore Obsy.	1015·2	— 0·5	83	55	78·6	58·9	68·7	+ 2·2	59·5	87	0·8	0·00	— 0·24	0*	..	..
Bombay	1013·1	— 0·4	93	64	87·5	70·1	78·8	+ 1·4	68·3	73	0·8	0·00	— 0·05	0*	..	..
Madras	1013·6	+ 0·1	85	65	82·9	69·5	76·2	— 0·5	72·0	87	4·0	3·07	— 2·28	3*	..	..
Colombo, Ceylon	1011·1	+ 0·8	89	67	85·4	71·7	78·5	— 1·0	74·0	77	5·0	5·73	+ 0·61	12	7·3	62
Singapore	1009·6	— 0·1	90	71	86·7	72·8	79·7	— 0·2	75·3	78	7·1	2·46	— 8·10	15	5·8	48
Hongkong	1020·1	+ 0·4	79	47	67·7	58·5	63·1	+ 0·1	56·7	66	5·9	4·11	+ 3·08	6	5·4	50
Sandakan	..	..	91	72	84·7	73·9	79·3	— 0·9	78·5	99	8·5	30·28	+ 11·64	25	..	..
Sydney, N.S.W.	1010·6	— 1·3	97	54	76·2	62·1	69·1	— 1·0	63·9	63	5·5	4·27	+ 1·41	12	8·6	60
Melbourne	1012·0	— 0·7	94	46	73·0	52·1	62·5	— 2·3	56·0	60	6·2	4·33	+ 2·06	14	7·4	50
Adelaide	1013·5	+ 0·3	103	48	80·6	57·0	68·8	— 2·3	57·0	38	5·1	0·28	— 0·72	6	9·8	68
Perth, W. Australia	1013·2	0·0	96	50	80·6	59·9	70·3	— 0·5	60·3	48	2·6	0·20	— 0·36	2	11·1	78
Coolgardie	1012·0	+ 0·8	106	45	89·2	58·7	73·9	— 1·8	60·0	44	2·7	0·44	— 0·25	3	..	..
Brisbane	1011·7	— 0·3	91	62	83·8	66·6	75·2	— 1·2	67·3	56	5·6	2·49	— 2·48	7	9·4	68
Hobart, Tasmania	1007·9	— 1·8	89	43	67·7	49·4	58·5	— 1·7	52·0	54	7·1	2·47	+ 0·48	12	7·7	50
Wellington, N.Z.	1013·8	+ 1·6	76	44	65·1	52·1	58·6	— 1·6	54·6	69	7·5	2·60	— 0·62	9	7·0	46
Suva, Fiji	1008·0	— 0·6	91	72	85.8	74·5	80·1	+ 1·1	75·6	82	7·5	13·99	+ 1·47	27	4·6	35
Apia, Samoa	1007·7	— 0·6	89	72	85·8	75·7	80·8	+ 1·5	77·7	78	6·6	15·24	+ 1·35	24	7·0	54
Kingston, Jamaica	1013·6	— 0·4	91	66	87·4	69·8	78·6	+ 0·9	67·3	83	3·7	0·11	— 1·48	3	7·3	66
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1019·2	+ 1·6	57	2	36·9	23·9	30·4	+ 3·3	26·7	73	7·2	2·05	— 0·42	8	2·7	30
Winnipeg	1015·8	— 2·9	39	—34	12·4	—7·0	2·7	— 3·1	..	..	4·2	0·00	— 0·94	0	3·2	39
St. John, N.B.	1018·7	+ 4·7	55	— 4	37·0	21·7	29·3	+ 4·9	25·3	84	5·8	2·29	— 1·88	11	3·6	41
Victoria, B.C.	1018·5	+ 1·8	52	18	42·0	35·1	38·5	— 2·6	36·1	84	6·8	3·91	— 1·83	15	2·9	35

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Climatological Table for the British Empire, Year 1932.

STATIONS	Pressure: Mean of Day M.S.L. mb.	Pressure: Diff. from Normal mb.	Temperature: Absolute Max. °F.	Temperature: Absolute Min. °F.	Temperature: Mean Values Max. °F.	Temperature: Mean Values Min. °F.	Temperature: Mean Values ½ max. and min. °F.	Temperature: Mean Values Diff. from Normal °F.	Temperature: Mean Wet Bulb °F.	Relative Humidity %	Mean Cloud Am'nt 0—10	Precipitation: Am'nt in.	Precipitation: Diff. from Normal in.	Precipitation: Days	Bright Sunshine: Hours per day	Bright Sunshine: Percentage of possible
London, Kew Obsy.	1016·4	+ 1·0	92	22	56·7	44·1	50·4	+ 0·7	45·6	87	7·1	21·99	− 1·81	153	3.4	26
Gibraltar	1017·8	− 0·1	91	38	71·1	56·0	63·5	− 0·7	55·5	82	4·7	37·89	+ 2·07	103	..	..
Malta	1017·1	+ 1·7	92	41	70·7	60·6	65·7	− 0·4	60·4	76	4·9	22·65	+ 2·79	80	8·5	68
St. Helena	1015·1	+ 0·5	72	51	63·3	56·7	60·0	− 1·5	57·5	94	9·3	33·86	..	198	..	..
Freetown, Sierra Leone	1013·3	+ 1·9	91	67	85·1	73·7	79·3	− 1·4	75·2	83	6·3	132·30	− 24·93	185	..	..
Lagos, Nigeria	1011·7	+ 0·9	92	68	85·3	74·9	80·1	− 0·6	74·9	83	7·7	48·09	− 23·89	110	5·6	47
Kaduna, Nigeria	1012·6	− 1·0	102	48	88·9	..	..	..	67·1	66	5·7	46·02	− 7·81	94	7·3	61
Zomba, Nyasaland	1011·7	− 0·6	93	44	79·5	59·9	69·7	+ 0·3	..	69	5·5	39·09	− 15·45	91	..	..
Salisbury, Rhodesia	1015·0	− 0·3	91	32	76·6	53·8	65·2	− 0·1	56·9	59	4·3	26·77	− 4·68	96	7·2	60
Cape Town	1017·3	+ 0·3	101	39	72·7	55·3	63·9	+ 1·6	56·5	77	4·7	23·70	− 1·34	108	..	..
Johannesburg	1015·4	+ 0·4	89	26	71·7	50·3	61·0	+ 1·3	50·2	51	3·2	21·53	− 11·69	96	8·9	75
Mauritius	1016·0	− 0·1	90	54	80·1	67·6	73·8	− 0·2	69·9	72	6·0	58·89	+ 9·23	256	7·7	64
Calcutta, Alipore Obsy.	1007·3	− 0·3	105	51	88·3	72·3	80·3	+ 1·5	72·7	86	4·6	62·90	− 1·42	92*	..	..
Bombay	1008·7	− 0·5	96	64	88·4	75·2	81·8	+ 1·2	74·0	78	4·3	73·66	+ 1·47	..	..	..
Madras	1008·7	− 0·1	107	63	89·8	75·1	82·5	− 0·6	75·0	76	5·5	46·49	− 3·07	51*	..	..
Colombo, Ceylon	1010·1	+ 0·4	94	62	85·8	74·7	80·3	− 0·7	76·3	78	6·3	123·90	+ 43·77	197	6·8	56
Singapore	1009·5	0·0	92	69	86·8	73·9	80·4	− 0·5	76·5	80	7·0	77·49	− 17·63	185	6·0	49
Hongkong	1013·0	+ 0·5	91	43	76·8	68·8	72·8	+ 0·5	67·7	75	7·1	91·47	+ 5·74	133	5·1	43
Sandakan	..	..	94	70	86·9	74·9	80·9	− 0·4	77·1	84	..	139·57	+ 14·78	203	..	..
Sydney, N.S.W.	1015·6	− 0·3	106	36	70·7	56·0	63·4	+ 0·3	58·2	71	6·0	37·47	− 10·01	146	6·8	56
Melbourne	1016·2	− 0·1	109	33	66·8	49·3	58·1	− 0·3	52·7	71	6·9	31·08	+ 5·61	179	4·8	39
Adelaide	1016·9	− 0·1	110	37	72·1	53·0	62·6	− 0·4	54·5	56	6·1	25·04	+ 3·86	141	6·4	52
Perth, W. Australia	1016·9	+ 0·5	106	38	73·7	55·9	64·8	+ 0·6	56·9	61	4·7	39·40	+ 5·03	121	8·0	65
Coolgardie	1016·0	+ 0·1	112	31	77·4	51·7	64·5	0·0	54·0	54	3·4	10·74	+ 0·47	58	..	..
Brisbane	1016·1	+ 0·2	99	41	77·8	60·2	69·0	+ 0·1	62·1	63	4·9	24·79	− 20·50	97	8·1	67
Hobart, Tasmania	1013·1	+ 0·6	93	32	61·7	46·9	54·3	− 0·1	48·7	67	6·6	30·29	+ 6·50	156	5·6	45
Wellington, N.Z.	1016·2	+ 1·5	77	32	58·7	47·6	53·1	− 2·2	50·3	76	6·9	38·87	− 9·17	147	5·6	46
Suva, Fiji	1011·3	0·0	92	65	83·3	72·7	77·9	+ 0·9	73·8	81	7·0	121·69	+ 4·55	258	5·1	42
Apia, Samoa	1009·7	− 0·6	90	66	85·4	74·4	79·9	+ 1·4	76·7	77	5·5	123·94	+ 14·23	202	7·1	59
Kingston, Jamaica	1012·6	− 1·1	94	64	87·5	71·6	79·6	+ 0·3	70·4	81	4·4	21·95	− 11·64	87	7·6	63
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1015·8	− 0·8	95	2	55·2	40·3	47·7	+ 2·5	42·4	75	5·6	30·70	− 0·58	116	5·6	44
Winnipeg	1016·3	+ 0·1	92	−34	45·8	26·0	35·9	+ 1·3	..	..	5·1	12·76	− 7·43	60	..	..
St. John, N.B.	1014·1	− 0·5	81	− 4	50·3	35·4	42·8	+ 1·6	38·9	78	6·1	41·94	− 6·14	144	..	..
Victoria, B.C.	1017·4	+ 0·7	88	16	55·0	44·2	49·6	+ 0·2	46·5	82	6·3	33·83	+ 3·52	152	5·9	45

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(*continued from page 128*)

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	188	+ 3	Liverpool	149	—50
Aberdeen	125	—62	Ross-on-Wye	160	—43
Dublin	147	—58	Falmouth	199	—32
Birr Castle	147	—35	Gorleston	195	—30
Valentia	158	—45	Kew	173	—28

The special message from Brazil states that the rainfall in the northern regions was very scarce with 2·13 in. below normal, and in the central and southern regions scarce with 0·71 in. and 0·79 in. below normal respectively. Four anticyclones crossed the country and excessive cold was experienced in the south. The weather conditions were good for the gathering of the coffee, cotton, tobacco and cereal crops. At Rio de Janeiro pressure was 1·9 mb. above normal and temperature 1·1°F. below normal.

Miscellaneous notes on weather abroad culled from various sources. "Red rain" lasting generally 10 to 15 minutes but long enough to colour trees, housetops and roads a reddish yellow occurred in northern Italy on the 3rd and 4th. A cloudburst occurred in the Upper Allgäu, Germany, on the 4th. Snow fell in Switzerland down to a level of 4,000 ft. before the 12th, and Alpine passes opened to vehicles were again blocked—at 6,000 ft. the snow was over 3 ft. deep. Navigation reopened at Uleaborg on the 23rd. May, 1933, was the wettest May in Bavaria since records began 86 years ago; the rainfall at Munich was 9·8 in. compared with an average of 3·6 in. (*The Times*, May 6th—June 5th.)

A cloudburst in the Puniwhakau district, 27 miles east of Stratford, New Zealand, about the 7th, devastated hundreds of acres of farm land and obliterated roads and bridges. (*Morning Post*, May 8th.)

Twenty-one persons were killed in a tornado which swept over western Alabama on the 5th. (*The Times*, May 6th.)

Reports from Canada show that the weather at the beginning of the month there was generally fair, cool and somewhat windy. Except for the Gulf States the temperature over the United States was below normal during the first week of the month, becoming above normal in the following week in the eastern States and after the middle of the month in the Middle States, but remaining below normal throughout along the Pacific Coast. Rainfall was generally in excess at the beginning of the month but deficient later on. (*The Times*, May 8th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

General Rainfall for May, 1933

England and Wales ...	97	per cent of the average 1881-1915.
Scotland	69	
Ireland	114	
British Isles	94	